

REMARKS

Applicants have amended their specification at page 6, to correct a mistranslation; and have corrected the description of diisocyanates of the urethane acrylate-based oligomers as set forth in the paragraph bridging pages 57 and 58 of Applicants' specification. In connection with the amendment at page 6 of Applicants' specification, note, for example, page 17, second paragraph, of Applicants' specification. It is respectfully submitted that these amendments to the specification do not add new matter to the application.

Applicants have amended their claims in order to further clarify the definition of various aspects of the present invention. In particular, Applicants have cancelled claim 1 without prejudice or disclaimer, and substitute therefor new claim 33 as the sole independent claim in the application. Claim 33, as compared with previously considered claim 1, incorporates therein subject matter of claims 4 and 5; additionally recites weight average molecular weight and Tg of the polyimide resin; and recites measuring conditions of the $\tan \delta$ peak temperature and flow amount. Note, for example, pages 24, 45 and 46 of Applicants' specification. In light of substitution of claim 33 for claim 1, dependencies of various of the claims previously in the application have been amended, and claims 4 and 5 have been cancelled without prejudice or disclaimer. Furthermore, claim 19 has also been cancelled without prejudice or disclaimer; and claim 26 has been amended to recite the adhesive film "according to claim 16".

The elections in response to the restriction requirement/election-of-species requirement in the Office Action mailed September 20, 2007, set forth in the Response filed December 13, 2007, are noted and confirmed. Also

noted are the claims being withdrawn from consideration, based upon these elections. It is respectfully submitted, however, that upon allowance of generic claims in the application, the claims directed to non-elected species should be re-joined in the above-identified application and allowed to issue in a patent therefrom.

In addition, it is respectfully submitted that where claims directed to the adhesive film as presently being considered on the merits in the above-identified application are allowable, then claims directed to an adhesive sheet and to a semiconductor device, each using such adhesive film, should also be allowable. Accordingly, upon allowance of, e.g., claim 33, it is respectfully requested that the Examiner re-consider and rejoin the Groups II and III claims, as in the Office Action mailed September 20, 2007, in the above-identified application, and allow such Groups II and III claims to issue in a U.S. patent based upon the above-identified application.

The objection to claim 26 as set forth in Item 2 on page 2 of the Office Action mailed March 27, 2008, is noted. Claim 26 has been amended to be dependent on claim 16; accordingly, the objection thereto is moot.

Rejection of claim 19 under the second paragraph of 35 U.S.C. §112, set forth in Item 3 bridging pages 2 and 3 of the Office Action mailed March 27, 2008, is moot, in light of cancellation of claim 19 without prejudice or disclaimer.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed March 27, 2008, that is, the teachings of U.S. Patent Application

Publication No. 2001/0035533 to Takeda, et al, and Japanese Patent Document No. 11-140386 (designated by the Examiner as "Takashi et al."), under the provisions of 35 U.S.C. §102 and 35 U.S.C. §103.

Initially, it is noted that the Examiner has rejected only claim 1 over the teachings of Takeda, et al. Moreover, claim 33, the sole independent claim presently in the application, incorporates therein at least the subject matter of previously considered claim 4. In view thereof, it is respectfully submitted that the rejection on prior art grounds, over the teachings of Takeda, et al, is clearly moot.

As for the rejection over the teachings of No. 11-140386, it is respectfully submitted that the teachings of this reference would have neither disclosed nor would have suggested such an adhesive film as in the present claims, having, inter alia, the polyimide resin with SP value, weight average molecular weight and Tg as in the present claims, and having amounts of epoxy resin and polyimide resin as in the present claims, the adhesive film having a tan δ peak temperature and flow amount as in the present claims; and, moreover, wherein the polyimide resin contains one or more kinds of polyimide resin, at least one of which is obtained utilizing a diamine and acid dianhydride satisfying the condition where a difference between heat generation initiating temperature and heat generation peak temperature is a value as in the present claims, with such polyimide obtained by reacting such diamine and such acid dianhydride being contained at 50% by weight or more of a total polyimide resin. See claim 33.

Furthermore, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested

such adhesive film as in the present claims, having features as discussed previously in connection with claim 33, and, moreover, wherein the epoxy resin contains a tri-or more functional epoxy resin and/or an epoxy resin which is solid at room temperature (note claim 2); and/or wherein the adhesive film also contains an epoxy resin curing agent (see claim 6) or a filler (see claim 15); and/or wherein at a stage where the adhesive is laminated on a silicon wafer at 80°C, a 90°C peeling force at 25°C to the silicon wafer is 5N/m or larger (see claim 20).

The present invention as claimed in the above-identified application is directed to an adhesive film, as well as an adhesive sheet and a semiconductor device using such film.

Previously, in connecting a semiconductor chip and a semiconductor chip-carrying support member, a silver paste has been mainly used. However, with recent miniaturizations, it has been necessary to find other materials for such connection.

In addition, through recent advances in miniaturization and thinning of semiconductor chips, wherein such chips and the wafer from which such chips are formed is very thin, the wafer is fragile and is easily cracked; and, in order to prevent this, a procedure of applying, as a protecting tape, a polyolefin-based back grind tape to the surface of the wafer has been adapted. However, since a softening temperature of the back grind tape is 100°C or lower, it has been demanded that an adhesive film, which can be laminated on a back of a wafer at a temperature of 100°C or lower, be provided. Note the sole full paragraph on page 3 of Applicants' specification. Furthermore, it is required that easy peelability be achieved between the

adhesive film and a dicing tape, and it is desired that the adhesive film has a low temperature laminating property and resistance to re-flowability, so that a reliable package can be achieved.

Against this background, and in light of the desire to provide an adhesive film having both a low temperature laminating property and resistance to re-flowability, Applicants achieve this objective by the adhesive film of the present invention, utilizing a polyimide resin having properties as set forth in the present claims, with amount of polyimide resin and epoxy resin in the adhesive film as in the present claims, and with the adhesive film having a $\tan \delta$ peak temperature and flow amount as in the present claims.

By utilizing a polyimide having a T_g as in the present claims, the adhesive film has a desired laminating temperature, adverse effects on a back grind tape are avoided, and warpage of a semiconductor wafer is suppressed. Note, for example, the paragraph bridging pages 23 and 24 of Applicants' specification. By utilizing a polyimide having a weight average molecular weight as in the present claims, acceptable film-forming properties, and strength of the film, are achieved, while deterioration of flowability at heating and reduction of embedding properties in irregularities on a substrate, are avoided. Moreover, by using a polyimide with T_g and a weight average molecular weight of the polyimide as in the present claims, not only a laminating temperature can be reduced, but also a heating temperature (die bonding temperature) when a semiconductor chip is adhered and fixed to a semiconductor chip-carrying support member can be reduced, and an increase of warpage of a chip can be suppressed. Note the paragraph bridging pages 24 and 25 of Applicants' specification.

By utilizing a polyimide resin also having a SP value as in the present claims, a reduced intramolecular cohesive force is avoided, so that an increase in hot flowability of an adhesive film in B stage does not become unduly large, and a reduction in adherability of the adhesive film with a substrate is avoided, while an increase in water absorption of an adhesive film is avoided. Note the last full paragraph on page 25, as well as the paragraph bridging pages 25 and 26, of Applicants' specification.

It is noted that according to the present invention, a desired $\tan \delta$ peak temperature is achieved while still including a polyimide resin of a desired SP value, as described in the last full paragraph on page 28 of Applicants' specification.

As to advantages of the present invention having a $\tan \delta$ peak temperature and flow amount as in the present claims, note also the paragraph bridging pages 45-47 of Applicants' specification. In addition, and noting, for example, claim 20, by an adhesive film having a peeling force as in the present claims, picking up of the chip after dicing is facilitated. Note, for example, the second full paragraph on page 47 of Applicants' specification.

No. 11-140386 discloses an adhesive film of which the weight loss after heating for two minutes at 250°C is 100 μf or less per mm^3 of the film. Such film is obtained by mixing a thermoplastic resin, a thermosetting resin having a molecular weight of 400-1500, and if necessary a filler, in an organic solvent; forming a layer, from the resultant mixture, on a substrate; heating and drying the layer; and removing the substrate. This patent document goes on to disclose that a polyimide resin is suitable as the thermoplastic resin, and an epoxy resin as the thermosetting resin. Note the English-language

abstract of No. 11-140386. See also paragraphs [0001], [0008], [0015] and [0018] of the machine-generated English translation of No. 11-140386.

It is respectfully submitted that No. 11-140386 would have neither disclosed nor would have suggested the presently claimed adhesive film, including, inter alia, the SP value and weight-average molecular weight, or Tg, of the polyimide; or amount of polyimide resin and epoxy resin; or wherein the polyimide resin contains at least one polyimide resin obtained by reacting the specified diamine and acid dianhydride satisfying the condition as in claim 33; or tan δ peak temperature and flow amount as in the present claims, and advantages thereof, as discussed in the foregoing.

It is emphasized that the present invention achieves both a low temperature laminating property and resistance to re-flowability, using a specific polyimide resin having specific properties, using specific raw materials of the polyimide, and as well by using specific amounts of polyimide resin and epoxy resin, as in the present claims. It is respectfully submitted that No. 11-140386, directed to different objectives (that is, withstanding soldering heat in mounting, reduction of generation of an outgas and avoiding staining of semiconductor elements or a heating apparatus), would have neither disclosed nor would have suggested the presently claimed adhesive film, including materials with properties as in the present claims, and with amounts of the materials, and advantages achieved thereby.

The contention by the Examiner in Item 9 on page 4 of the Office Action mailed March 27, 2008, that given the description in No. 11-140386 with respect to mixing polyimide resin and epoxy resin, it "is reasonable to presume that [the properties of SB, tan δ peak temperature of adhesive film

and flow amount] are present in the invention of [No. 11-140386],” is respectfully traversed. As seen in the foregoing, as well as from a full review of Applicants’ disclosure, Applicants provide guidance in connection with choosing specific materials and amounts thereof, having properties as in the present claims, achieving advantages as discussed previously. Particularly in light thereof, it is respectfully submitted that the description in No. 11-140386, directed to different properties of the described adhesive, would have neither disclosed nor would have suggested the present adhesive film, including incorporating a polyimide resin having properties as discussed previously, with the adhesive film having properties as discussed previously, and advantages due thereto.

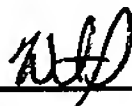
The contention by the Examiner with respect to previously considered claim 5, in Item 12 on pages 5 and 6 of the Office Action mailed March 27, 2008, is noted. However, where the processing provides a different product, it is respectfully submitted that such processing must be considered in determining patentability. Furthermore, it is respectfully submitted that the present claims define a product including an polyimide resin, made by reacting specific reactants, and is respectfully submitted that such product is defined by the reaction product of the recited reactants. It is respectfully submitted that the Examiner must give weight to the polyimide resin, formed from reactants by the reaction as recited in the present claims, including the reactants which form the recited polyimide resin.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims being considered on the merits in the above-identified application are respectfully requested. In addition, rejoinder of

claims directed to non-elected species, with allowance of such claims in the above-identified application, is respectfully requested; and it is further respectfully requested that the Examiner re-join claims directed to the Groups II and III inventions as set forth in the Office Action mailed September 20, 2007, and allow such claims to also issue in a U.S. Patent on the above-identified application.

To the extent necessary, Applicants petition for an extension of time under 37 CFR §1.136. Please charge any shortage in the fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account No. 01-2135 (Case No. 1204.45684X00) and please credit any excess fees to such deposit account.

Respectfully submitted,

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Attachments